

# Raspberry Pi talks EnOcean -

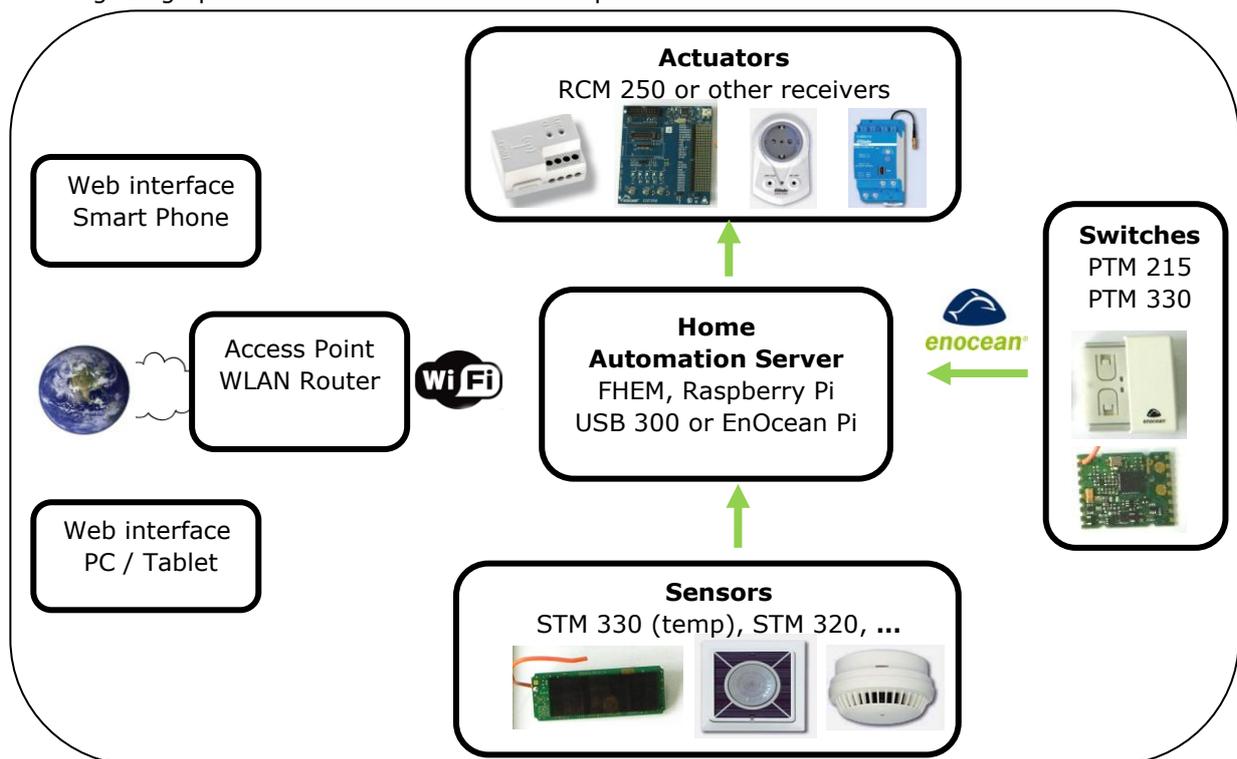
## How to setup a home automation server with EnOcean Pi or USB 300

### 1. Introduction

Self-powered sensors and switches are ideal for enthusiasts to start up with home automation. No cable is required to switch lights, control blinds and get sensor information like temperature, humidity or presence detection.

Sensors and actuators can directly communicate to each other or they can additionally be controlled with an intelligent smart home server. This allows enthusiasts to get home automation for remote sensing and remote control via PC or smart phones. Raspberry Pi is the ideal platform to setup a smart home server. A USB 300 or EnOcean Pi will act as a bridge (GatewayController) to the EnOcean radio world. Self-powered switches and sensor from the EnOcean starter kit ESK 300, developer kit EDK 350 or Pi Sensor Kit PSK 300 can be used for the first installation.

Following image provides an overview of the components:



Raspberry Pi with FHEM server acts as home automation server. The server can be used to automate common tasks like switching lamps, scene illuminations or pulling blinds, measure and visualize power consumption, temperature and humidity.

The server receives and sends EnOcean radio telegrams via USB 300 or EnOcean Pi. Solar powered radio sensors (e.g. STM 330 temperature sensor or STM 320 reed contact sensor) periodically send values which will be interpreted and displayed via FHEM web interface. Self-powered switches and FHEM send on/off and dim commands to actuators.

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### 1.1 Covered Topics

- Installation of Raspberry Pi and preparation for smart home projects
- Connection of a USB 300 or EnOcean Pi to Raspberry Pi
- Installation of the FHEM server for home automation
- Configuration of FHEM for EnOcean switches, sensors and actuators

### 1.2 Necessary components

- **PC** with internet browser
- **Raspberry Pi** board (model B)
- **Raspberry Pi accessories:**  
power supply (~1A) with micro USB plug, HDMI cable, SD card (e.g. 8GB), Ethernet cable or USB WLAN stick
- **USB 300** e.g. from EnOcean starter kit ESK 300 or developer kit EDK 350



or

- **EnOcean Pi**  
with TCM 310  
GatewayController
- **Pi Sensor Kit PSK 300**  
with temperature sensor STM 330,  
reed contact sensor STM 32x and  
Switch PTM 2xx



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## 2. Step by step installation of Raspberry Pi

### 2.1 Installation of Raspian (Debian Linux for Raspberry Pi)

If Raspian image is not already installed on the SD card, download NOOBS (New Out of the Box Software) and follow the instructions at: <http://www.raspberrypi.org/downloads>

### 2.2 Basic configuration via "raspi-config" command

1. Plug SD card into Raspberry Pi and connect with keyboard and monitor
2. Connect to internet via Ethernet (just plug connector) or WiFi (needs to be configured). If there is already a device driver installed (e.g. Wi-Pi or EdiMax). Start GUI with `startx` and click on WiFi config.
3. Login with user `pi` and password `raspberrypi`
4. Configuration menu starts automatically after booting, if not just type `sudo raspi-config`

```

Setup Options
  1 Expand Filesystem      Ensures that all of the SD card storage is available to the OS
  2 Change User Password  Change password for the default user (pi)
  3 Enable Boot to Desktop Choose whether to boot into a desktop environment or the command-line
  4 Internationalisation Options Set up language and regional settings to match your location
  5 Enable Camera         Enable this Pi to work with the Raspberry Pi Camera
  6 Add to Rastrack       Add this Pi to the online Raspberry Pi Map (Rastrack)
  7 Overclock             Configure overclocking for your Pi
  8 Advanced Options     Configure advanced settings
  9 About raspi-config    Information about this configuration tool

                                <Select>                                <Finish>
  
```

5. Select following items to configure:
  - `expand_rootfs` to use the full SD card size
  - `configure_keyboard` to have the right keyboard settings
  - `change_timezone` for correct time & date
  - `change_location` for country specific characters etc.

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### 2.3 Software and Firmware update

Several shell commands need root (super user) rights; therefore "sudo" is used as prefix. Raspian (Linux operating system) can be updated via APT (Advanced Package Tool).

RPI-update (<https://github.com/Hexxeh/rpi-update>) is used to update the firmware (hardware driver) of Raspberry Pi. In order to have an up to date system (e.g. to recognize USB 300) both updates are required.

1. Get latest updates of Raspian and Raspberry Pi firmware:

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install rpi-update
```

2. Reboot

```
sudo reboot
```

### 2.4 Connecting Raspberry with USB 300

1. Connect USB 300 to Raspberry Pi board
2. Check availability of USB 300 with `lsusb`



Example:

```
Bus 001 Device 002: ID 0424:9512 Standard Microsystems Corp.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 001 Device 003: ID 0424:ec00 Standard Microsystems Corp.
Bus 001 Device 004: ID 0403:6001 Future Technology Devices
International, Ltd FT232 US B-Serial (UART) IC
-> USB 300 with FT332 chip has been recognized
```

3. Install FHEM and start FHEM server. USB 300 will be configured automatically.
4. (Optional) If you want to do a manual check, perform following steps:

Set serial interface to 57.600 Baud for USB 300:

```
sudo stty -F /dev/ttyUSB0 57600
```

Display USB / serial data:

```
sudo hexdump < /dev/ttyUSB0
```

Example output:

```
0000000 0055 5d0a 00f4 ff01 ffff 5cff 3000 0055
0000010 070a eb01 00d1 21b0 0001 db8a 002e ff01
0000020 ffff 36ff 7e00 0055 070a eb01 00d1 21b0
0000030 0000 db8a 002e ff01 ffff 34ff c000 0055
0000040 070a eb01 00d1 21b0 0001 db8a 002e ff01
```

-> USB 300 provides a serial stream of EnOcean radio telegrams according to ESP3 protocol. For details see <http://www.enocean.com/esp>

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### 2.5 Connecting Raspberry with EnOcean Pi

1. Connect EnOcean Pi on top of Raspberry Pi board



2. Disable Linux using the serial port

As default the serial port of the GPIO interface is used for console debug outputs. In order to use this port for EnOcean Pi, this feature has to be disabled. Read more about this at: [http://elinux.org/RPi\\_Serial\\_Connection](http://elinux.org/RPi_Serial_Connection)

A script can be downloaded from Github, it will automatically adapt boot up settings: <https://github.com/lurch/rpi-serial-console>

3. Download script:

```
sudo wget https://raw.githubusercontent.com/lurch/rpi-serial-console/master/rpi-serial-console -O /usr/bin/rpi-serial-console && sudo chmod +x /usr/bin/rpi-serial-console
```

4. Execute script:

```
sudo rpi-serial-console disable
```

5. Install FHEM and start FHEM server. EnOcean Pi will be configured automatically. You can check incoming telegrams via FHEM event monitor, chapter 2.10.

```
192.167.1.121 - PuTTY
2013-08-08 16:31:34 EnOcean EnO_sensor_00035DF4 sensor3: 89
2013-08-08 16:31:34 EnOcean EnO_sensor_00035DF4 D3: 1
2013-08-08 16:31:34 EnOcean EnO_sensor_00035DF4 D2: 1
2013-08-08 16:31:34 EnOcean EnO_sensor_00035DF4 D1: 1
2013-08-08 16:31:34 EnOcean EnO_sensor_00035DF4 D0: 1
2013-08-08 16:31:37 Global global UNDEFINED EnO_sensor_0080D2E9 EnOcean 0080D2E9
2013-08-08 16:31:37 Global global DEFINED EnO_sensor_0080D2E9
2013-08-08 16:31:37 Global global SAVE
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 148
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 sensor1: 148
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 sensor2: 122
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 sensor3: 0
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 D3: 1
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 D2: 1
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 D1: 1
2013-08-08 16:31:37 EnOcean EnO_sensor_0080D2E9 D0: 1
2013-08-08 16:31:38 Global global UNDEFINED EnO_contact_00003FC6 EnOcean 00003FC6
2013-08-08 16:31:38 Global global DEFINED EnO_contact_00003FC6
2013-08-08 16:31:38 Global global SAVE
2013-08-08 16:31:38 EnOcean EnO_contact_00003FC6 open
2013-08-08 16:31:38 EnOcean EnO_contact_00003FC6 learnBtn: on
2013-08-08 16:31:44 EnOcean EnO_sensor_00035DF4 0
```

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### 2.5 Find out the IP address of your Raspberry Pi

In most cases the IP address is provided via DHCP server. For remote control via TTY (e.g. PuTTY) or HTML server connections (FHEM server) the IP address of Raspberry Pi is needed.

You can get your allocated IP address (e.g. by DHCP server) by typing in following command:  
`ifconfig`

Example output:

```
pi@raspberrypi ~ $ ifconfig
eth0      Link encap:Ethernet  HWaddr b8:27:eb:c3:32:73
          inet addr:192.167.1.121  Bcast:192.167.1.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1077688  errors:0  dropped:0  overruns:0  frame:0
          TX packets:68259  errors:0  dropped:0  overruns:0  carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:119175561 (113.6 MiB)  TX bytes:6098823 (5.8 MiB)
```

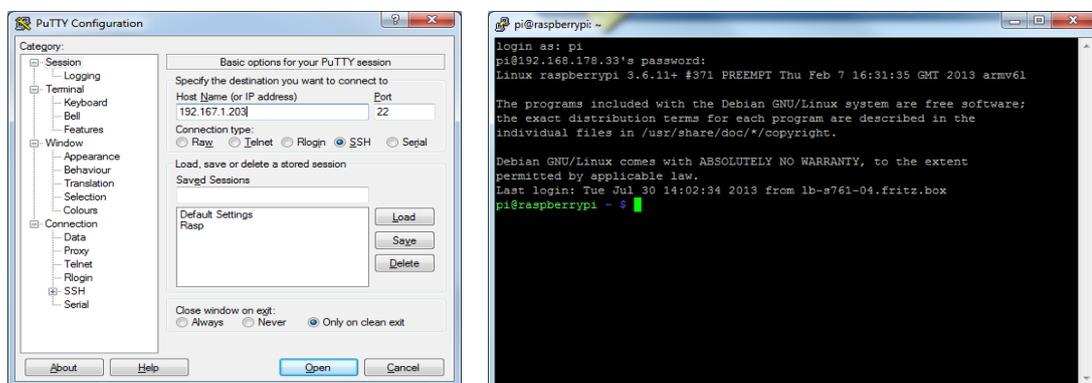
### 2.6 A remote control of your Raspberry Pi

If your desktop is too small for an additional Raspberry Pi display screen and keyboard, a remote control of your tiny computer is the best solution. Get the command line or Linux shell via SSH client to the PC browser.

1. Download and install PuTTY on PC

<http://www.chiark.greenend.org.uk/~sgtatham/putty/>

2. Execute PuTTY with IP address from your Raspberry Pi and login



➔ Now you have a command line interface to remotely control your Raspberry Pi via PC

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### 2.7 Installation of the building automation server

This example project uses the FHEM server available under GPL license. More details can be found on the FHEM website: <http://fhem.de/fhem.html>

1. Installation of Perl environment including libraries for FHEM

FHEM runs as server on a Perl interpreter, which needs to be installed.

```
sudo apt-get install perl libdevice-serialport-perl libio-socket-ssl-perl libwww-perl
sudo apt-get install -f
```

2. Installation FHEM

Please check <http://fhem.de/fhem.html#Download> for latest version and adapt installation commands below:

```
wget http://fhem.de/fhem-5.5.deb
sudo dpkg -i fhem-5.5.deb
```

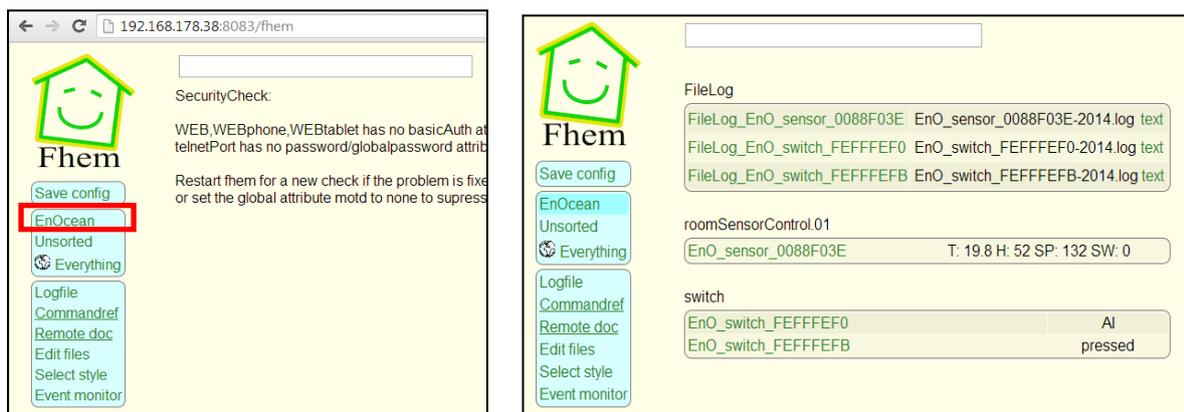
-> FHEM has been installed within the folder `/opt/fhem`. It starts automatically.  
Check [fhem.de](http://fhem.de) for updates and path to new version.

### 2.8 Display FHEM Web Interface

Start your browser and type following to the link field:

<http://<Raspberry Pi IP>:8083/fhem>

You will get the following user interface on the screen:



FHEM recognizes and configures automatically USB 300 or EnOcean PI. It receives radio telegrams from all EnOcean devices within the neighborhood (10-30m within buildings). Device entities will be created automatically for each new received EnOcean device (every EnOcean radio module or device has a unique manufacturer ID). Switches are by recognized by their specific RPS telegram, sensor types are recognized via learn button with 1BS or 4BS telegram. By default devices with EnOcean radio protocol will be to room EnOcean.

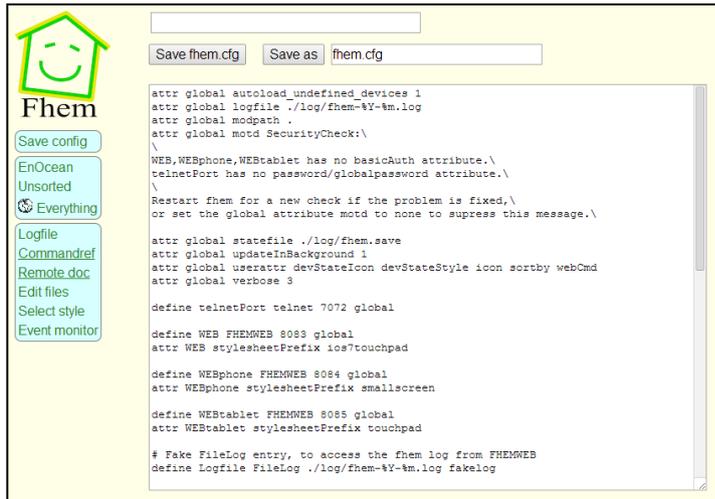
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### 2.9 FHEM auto configurations

FHEM server is configured via the configuration file fhem.cfg.

Start the configuration file editor via the FHEM menu item "Edit files".



#### Gateway:



If **USB 300** is plugged and configured to the Raspberry Pi correctly following code will be generated automatically by the FHEM autocreate function:

```
define TCM310_0 TCM 310 /dev/ttyUSB0@57600
```



If **EnOcean Pi** is plugged and configured to the Raspberry Pi correctly following code will be generated automatically by the FHEM autocreate function:

```
define TCM310_0 TCM 310 /dev/ttyAMA0@57600
```

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## Switch:

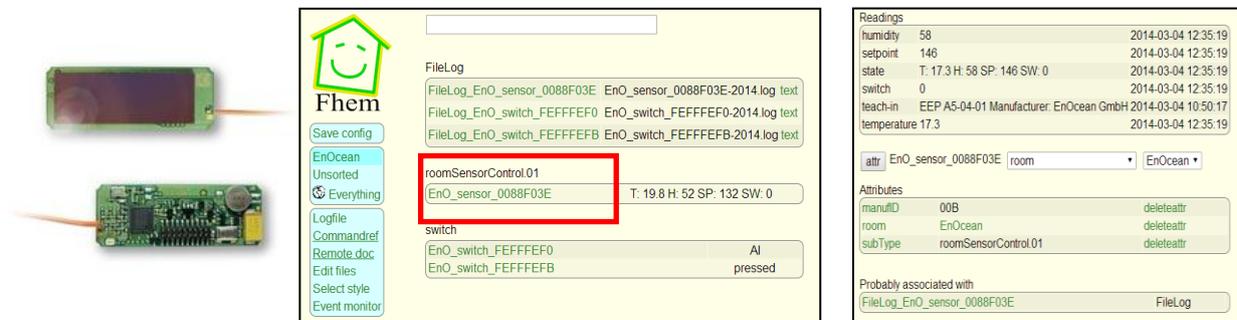


After you press the rocker the first time a new device entry is generated:

```
define EnO_switch_FEFFFFFFB EnOcean FEFFFFFFB
attr EnO_switch_FEFFFFFFB room EnOcean
attr EnO_switch_FEFFFFFFB subType switch
define FileLog_EnO_switch_FEFFFFFFB FileLog ../log/EnO_switch_FEFFFFFFB-%Y.log
  EnO_switch_FEFFFFFFB
attr FileLog_EnO_switch_FEFFFFFFB logtype text
attr FileLog_EnO_switch_FEFFFFFFB room EnOcean
```

Manufacturer ID is 0xFEFFFFFFB, telegram data will be logged automatically.

## Sensor:



This is an example of an temperature (room controller) sensor.  
After you press the learn button the time a new device entry is generated:

```
define EnO_sensor_0088F03E EnOcean 0088F03E
attr EnO_sensor_0088F03E manufID 00B
attr EnO_sensor_0088F03E room EnOcean
attr EnO_sensor_0088F03E subType roomSensorControl.01
define FileLog_EnO_sensor_0088F03E FileLog ./log/EnO_sensor_0088F03E-%Y.log EnO_sensor_0088F03E
attr FileLog_EnO_sensor_0088F03E logtype text
attr FileLog_EnO_sensor_0088F03E room EnOcean
```

Manufacturer ID is 0x0088F03E, telegram data will be logged automatically and can be displayed within a diagram.

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With the user interface you can visualize and configure graphical user elements to visualize events and send control telegrams to actuators.

A reference of FHEM commands for EnOcean can be found at:

<http://fhem.de/commandref.html#EnOcean>

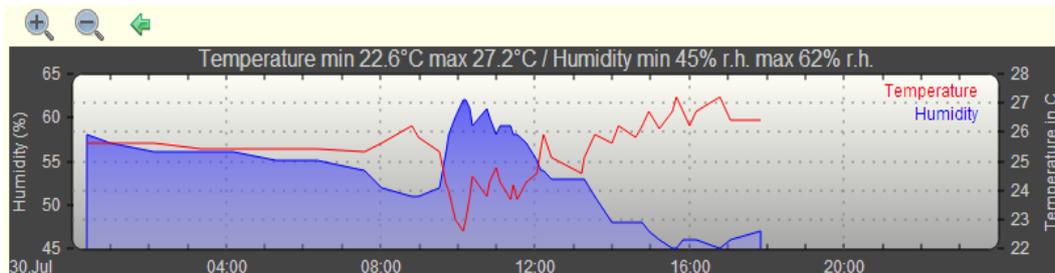
A small guide "how to" can be found at: <http://fhem.de/HOWTO.html>

For German users there is an additional forum available: <http://forum.fhem.de/>

### Example of visualization:

Following visualization example has been generated by STM 330 (temperature sensor) with HSM 100 (humidity sensor plugged):

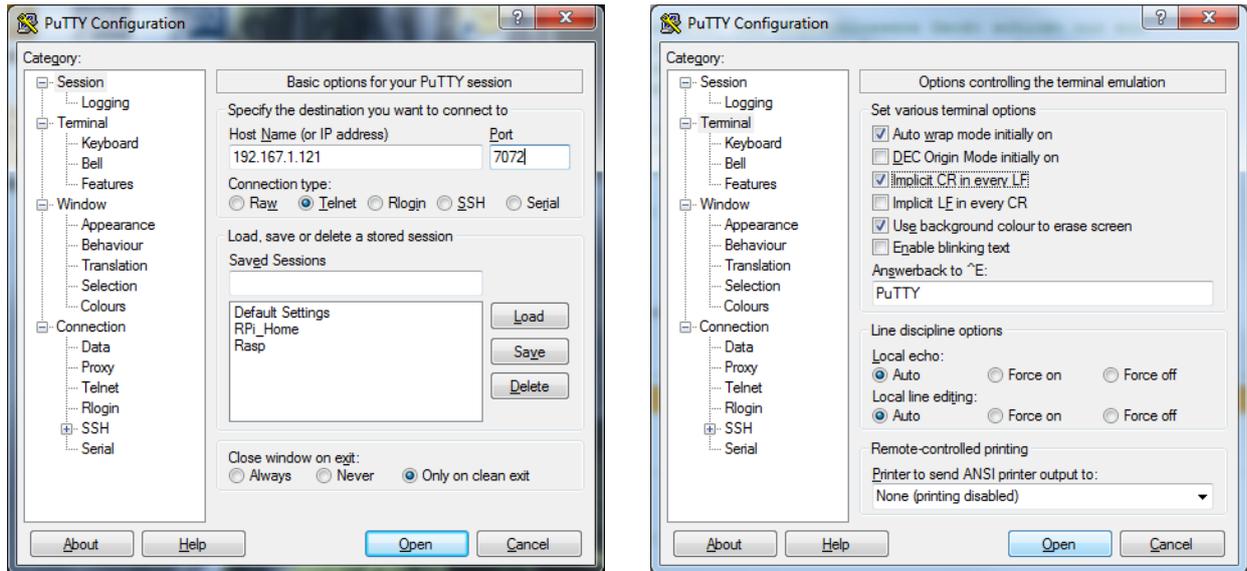
```
#ID:0088F03E STM_330 temperatur & humidty sensor
define Sensor_0088F03E EnOcean 0088F03E
attr Sensor_0088F03E manufID 00B
attr Sensor_0088F03E room EnOcean
attr Sensor_0088F03E subType roomSensorControl.01
define FileLog_EnO_sensor_0088F03E FileLog ./log/EnO_sensor_0088F03E-%Y.log Sensor_0088F03E
attr FileLog_Sensor_0088F03E logtype text
attr FileLog_Sensor_0088F03E room EnOcean
```



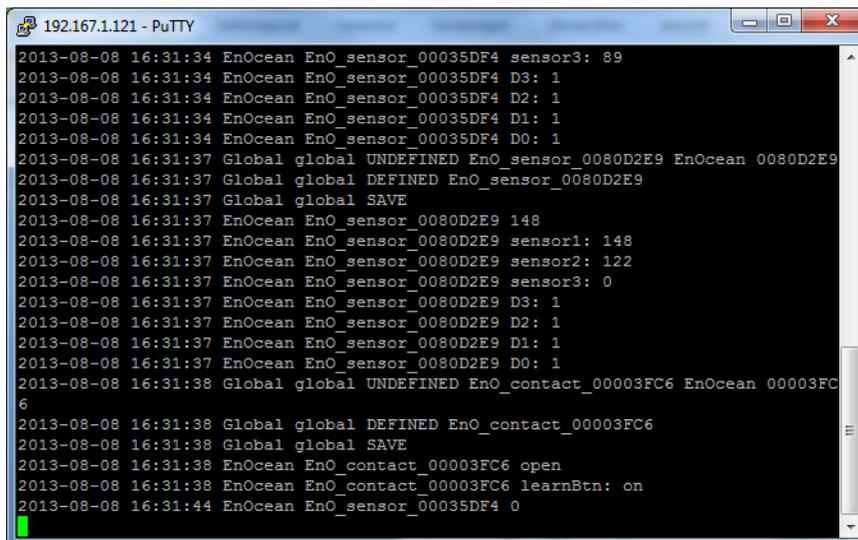
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## 2.10 Interpret EnOcean radio telegrams with FHEM event monitor

Start Putty and configure Putty to IP address of Raspberry PI with telnet port 7072. Switch on "implicit CR in every LF" within Terminal configuration to get a line feed after carriage return.



Start telnet session and type `inform timer` to get FHEM event monitor. Receiving events with EnOcean telegrams will be shown with time stamp.



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### 3. Useful links

#### EnOcean radio modules:

[http://www.enocean.com/en/enocean\\_modules/epk-350/](http://www.enocean.com/en/enocean_modules/epk-350/)

[http://www.enocean.com/de/enocean\\_module/usb-300-oem/](http://www.enocean.com/de/enocean_module/usb-300-oem/)

<http://www.enocean.com/de/enocean-pi/>

<http://www.enocean.com/en/knowledge-base/>

#### Farnell element 14 Raspberry Pi® and accessories:

<http://www.element14.com/raspberrypi>

[http://www.element14.com/enocean\\_pi](http://www.element14.com/enocean_pi)

#### Raspberry Pi®

<http://www.debian.org/doc/manuals/refcard/refcard.en.pdf>

<http://www.danielspage.de/index.php/technik/raspberry-pi-blog/44-enocean-auf-dem-pi>

<http://developer-blog.net/hardware/raspberry-pi-backup/>

<http://www.datenreise.de/raspberry-pi-wlan-einrichten-edimax/>

[http://www.mikrocontroller.net/articles/Raspberry\\_Pi](http://www.mikrocontroller.net/articles/Raspberry_Pi)

<http://pibeginners.com/ftp-server/>

#### FHEM:

<http://fhem.de/fhem.html>

<http://forum.fhem.de/>

<http://fhem.de/Heimautomatisierung-mit-fhem.pdf>